

IN THE SPECIFICATION:

On page 1, please amend the following paragraph:

-- This invention relates to electric discharge lasers and in particular to such lasers having chambers with long life electrodes. This application is a divisional of U.S. Serial No. 09/953,026, filed September 13, 2001, which invention is a continuation-in-part of U.S. Serial No. 09/590,958, filed June 9, 2000, now issued as U.S. Patent No. 6,560,263, U.S. Serial No. 09/590,961, filed June 9, 2000, now issued as U.S. Patent No. 6,466,602, U.S. Serial No. 09/703,697, filed November 1, 2000, now issued as U.S. Patent No. 6,363,094, U.S. Serial No. 09/742,485; filed December 20, 2000, U.S. Serial No. 09/768,753, filed January 23, 2001, now issued as U.S. Patent No. 6,414,979, and U.S. Serial No. 09/776,044, filed February 1, 2001, now issued as U.S. Patent No. 6,584,132.--

On page 3 and continuing on page 4, please amend the following paragraph:

“SUMMARY OF THE INVENTION

The present invention provides a gas discharge laser having an elongated cathode and an elongated anode with a porous insulating layer covering the anode discharge surface. A pulse power system provides electrical pulses at rates of at least 1 KHz. A blower circulates laser gas between the electrodes at speeds of at least 5 m/s and a heat exchanger is provided to remove heat produced by the blower and the discharges. In preferred embodiments at least a portion of the anode is comprised of lead, and fluorine ion sputtering of the anode surface creates the insulating layer (over the discharge surface of the anode) comprised in large part of lead fluoride. In a particular preferred embodiment the anode is fabricated in two parts, a first part having the general shape of a prior art anode with a trench shaped cavity at the top. This part is comprised of brass comprised of less than 1% lead. A second part comprised of brass having a lead content of greater than 3% is soldered into the trench and protrudes above the surface by about 0.2 millimeter. When the anode is installed in the laser and is

subjected to pulse discharges in a fluorine containing laser gas environment an insulating layer, comprising porous lead fluoride, forms on the surface of the second part protecting it from significant erosion. Applicants' computer electric field models have shown that the insulating layer does not significantly affect the electric field between the cathode and the anode. Since the first part does not contain lead, no significant insulating layer forms on it, but the electric field distribution prevents any significant portion of the discharges from being attracted to the surface of the second part. To the extent discharges do occur on the first part, erosion will occur at the discharge sites reducing the height of the anode in the region of the discharge which has the effect of reducing the discharge from the first part. About 50,000 small holes develop in the insulating layer on the second part which permit electrons to flow freely to and from the metal surface of the anode. However, fluorine ion sputtering on the metal surface of the anode is substantially limited after the insulating layer has developed. Applicants believe that the reduction in fluorine ion sputtering results from a reduced number of fluorine ions reaching the metal surface and a reduction in energy of the ions that do reach the metal surface."

On page 5 and continuing on page 6, please amend the following paragraph:

"Erosion

Applicants have discovered that electrode erosion occurs on both electrodes but that the erosion rate of the grounded electrode (anode 83) is about four times that of the high negative voltage electrode (cathode 84). In almost all other gas discharge devices where electrode erosion is a problem, e.g., flashlamps, it is the cathode where most of the erosion occurs. Anode erosion is unusual. Laser operation with brass electrodes can result in an insulating layer of metal fluorides being built up very gradually on portions of the anode. Applicants have discovered that the extent of the fluoride buildup is related to the lead content of the brass anode. For example, an anode comprised of

C26,000 brass having less than 1% lead does not produce a significant fluoride layer. However, an anode comprised of C36,000 brass with a 3 to 4% lead content produces a relatively uniform fluoride layer covering the entire discharge surface at a thickness of about 100 to 200 microns. In the regions covered by the fluoride layer, discharge current flows through tiny holes which typically tend to have approximately circular cross sections with diameters of about 20 to 150 microns. The surfaces covered by the fluoride layer do not suffer substantial further erosion, but if the fluoride layer is not uniform the erosion rate is increased on the non-covered discharge surfaces especially if the non-covered surface area decreases. There appears to be some erosion on the covered surfaces at the locations of the tiny holes, but this erosion is at least one, and possibl[e][y] two orders of magnitude less than that of the base metal.”

On page 10, please amend the following paragraph:

“First Preferred Embodiment

A first preferred embodiment of the present invention is a gas discharge laser such as KrF, ArF or F₂ having an elongated anode with the cross section shown in FIG. 6. The anode is comprised of two types of brass, the main body 40 of the anode 83 in C26000 brass which is 600 mm long. This anode is a modified version of a prior art anode which has been used extensively in these gas discharge lasers. The prior art 83 anode 83 has a cross section as shown in FIG. 5. The width at the bottom is 1.2 inches. The height to the center tip is 0.380 inch. The tip has a radius of 0.5 inch. The shoulder height from the bottom surface is 0.13 inch. The slanted sides are flat planes at an angle of 27.67 degrees with the bottom surface. Applicants have proven with many laser-years of operation that this general anode shape produces excellent electric field properties and excellent discharge performance along with very good laser gas flow compatibility. A trench-shaped cavity is cut into the top surface of anode 83. The cavity is 545 mm long, 3 mm wide at the top, 2.5 mm deep and 1.7 mm wide at the

bottom. The cavity is filled with a second brass part 42 which is cut to fit precisely in the cavity and extend above the surface by about 0.2 mm. The second brass part may be bonded in the cavity with Pb/Sn solder.”

On page 14, please amend the following paragraph:

“Porous Coating for Cathode

Until now cathode erosion in these gas discharge lasers has not been considered a problem since the anodes have eroded at about four times the rate of the cathodes. With the problem of anode erosion solved, cathode erosion could become a life limiting problem. Therefore, in another preferred embodiment, in addition to the anode the cathode discharge region is also covered with a porous insulating material. The reader should understand that a lead fluoride layer will not develop naturally on the cathode because it repels negatively charged fluorine ions during the main portion of the discharge pulse time.[7] However, a coated cathode could be produced in an F₂ environment with the cathode operating as an anode. Also, the other techniques described above for providing the porous insulating layer for the anode could be used to produce cathodes with porous insulating layers covering the discharge region. Those layers would protect the cathode from positive ion bombardment in the same manner as the described anode protective layers shield it from negative fluorine ion bombardment.”

IN THE DRAWING

Please substitute the formal drawings as accompanying this Preliminary amendment.